Executive Summary

Taiwan has always participated in combating global warming and climate change. In 2015, Taiwan enacted the “Greenhouse Gas Reduction and Management Act (hereinafter referred to as the Greenhouse Gas Management Act),” which legislates a 50% emission reduction target compare to 2005 Greenhouse levels by 2050 as the national long-term reduction target, and sets periodic goals every 5 years.

President Tsai Ing-wen declared on Earth Day on April 22, 2021: “The net-zero by 2050 is not only the goal of the world, but also the goal of Taiwan.” On August 30 of the same year, Premier Su Tseng-chang announced the amendment of the “Greenhouse Gas Reduction and Management Act” to form the “Climate Change Response Act,” including the “Goal of Net-Zero Emissions by 2050,” while presiding over the meeting of the National Council for Sustainable Development. In addition, the Executive Yuan has coordinated with related ministries and departments to set up a “Net-Zero Pathway Task Force” to carry out a net-zero emission roadmap assessment and planning based on the five major work spheres of “Decarbonized Energy,” “Industry and Energy Efficiency,” “Green Transport and Electrification of Transportation Vehicles,” “Negative Emissions Technologies” and “Governance.”

Taiwan voluntarily follows the Paris Agreement and made the commitment to officially incorporate the goal of net-zero emissions by 2050 into law. It also follows the spirit of the United Nations Framework Convention on Climate Change (UNFCCC), which requires UN parties to regularly disclose their climate policies and measurements and progress toward the targets. Taiwan has submitted the 2002 and 2011 editions of the National Communication successively, and issued the “2018 National Communications of the Republic of China (Taiwan) under the United Nations Framework Convention on Climate Change” in accordance with the Greenhouse Gas Management Act, fulfilling the requirement to prepare a National Communication every three years and establishing the specifications and chapter structure for the “National Communication” to

complete the “2021 National Communications of the Republic of China (Taiwan) under the United Nations Framework Convention on Climate Change,” which includes 8 Chapters, namely “National Conditions and Basic Environmental Information,” “Statistics and Trend Analysis of Greenhouse Gas Emissions and Absorption,” “Greenhouse Gas Reduction Policies and Measures,” “Greenhouse Gas Emission Prediction,” “Impacts of Climate Change and Adaptation Measures,” “Climate Change Scientific Research and Observations,” “International Collaboration and Exchanges,” and “Education, Training and Communication with the Public.” The highlights of each chapter are summarized as follows:

Chapter 1 National Conditions and Basic Environmental Information

Taiwan is located at the junction of East Asia and Southeast Asia and is surrounded by the sea. The terrain is mainly composed of mountains, hills, basins, tablelands, and plains. Mountains account for about two-thirds of the island’s total area, with a forest coverage of 60.71%, which is 2 times the global average. The annual average temperature is 24.6 ℃, and the average annual rainfall is 1,742.4 millimeters (mm).

In terms of population, the total population as of the end of 2020 is approximately 23.56 million, most of which are concentrated in municipalities, accounting for 69.45% of the total population. Owing to population aging and the impact of the COVID-19 pandemic, Taiwan started its negative population growth in 2020. With regard to economic development, the economic growth rate in 2020 reached 3.12%, a record high in the past three years.

The main source of the overall energy supply comes from fossil-fuels. In 2020, petroleum accounted for 44.17%, coal accounted for 30.00%, natural gas accounted for 17.17%; nuclear power generation accounted for 6.57%; biomass energy and waste accounted for 1.21%; hydropower accounted for 0.21%; solar photovoltaic, geothermal, and wind power together accounted for 0.59%; and solar thermal energy accounted for 0.08% of the total energy supply. The energy consumption was 8,540

kiloliters (kl) of oil equivalent, a 0.46% increase from 2019 or an 11.13% increase from 2005.

Chapter 2 Statistics and Trend Analysis of Greenhouse Gas Emissions and Absorption

The statistics on Taiwan's greenhouse gas emissions cover carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). Among the seven greenhouse gases, CO_2 accounts for the greatest amount of greenhouse gas emissions. Its emission in 2019 was 273.515 million tons of CO_2e (excluding LULUCF), accounting for 95.28% of the total greenhouse gases. The CO_2 emissions from fuel combustion accounted for 90.13% of the total CO_2 as shown in Figure 1.

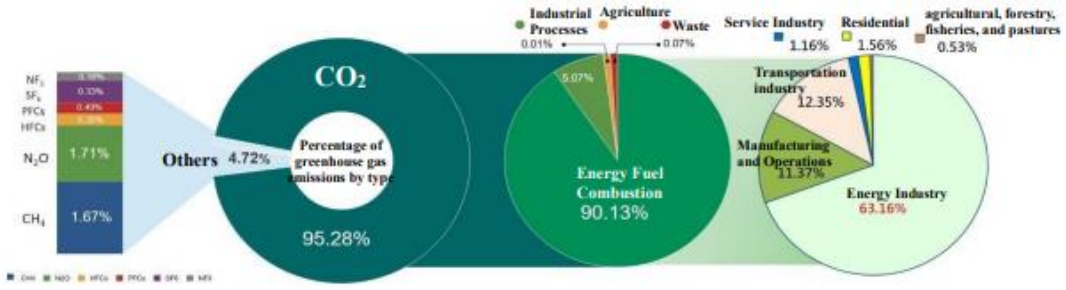

Figure 1: Percentage of greenhouse gas emissions by type in 2019

Taiwan's total greenhouse gas emissions in 2019 were 287.060 million tons of carbon dioxide equivalent (CO_2e), an increase of 108.35% compared to 1990 (137.776 million tons of CO_2e), and an average annual growth rate of 2.56%. Compared to 2005 (290.552 million tons of CO_2e), the total greenhouse gas emissions decreased by 1.20%, with an average annual growth rate of -0.16% as shown in Figure 2.

In terms of the type of gases, carbon dioxide is the largest greenhouse gas produced in Taiwan, followed by methane. The trends of greenhouse gas emissions in various sectors in Taiwan from 1990 to 2019 are shown in Figure 3.

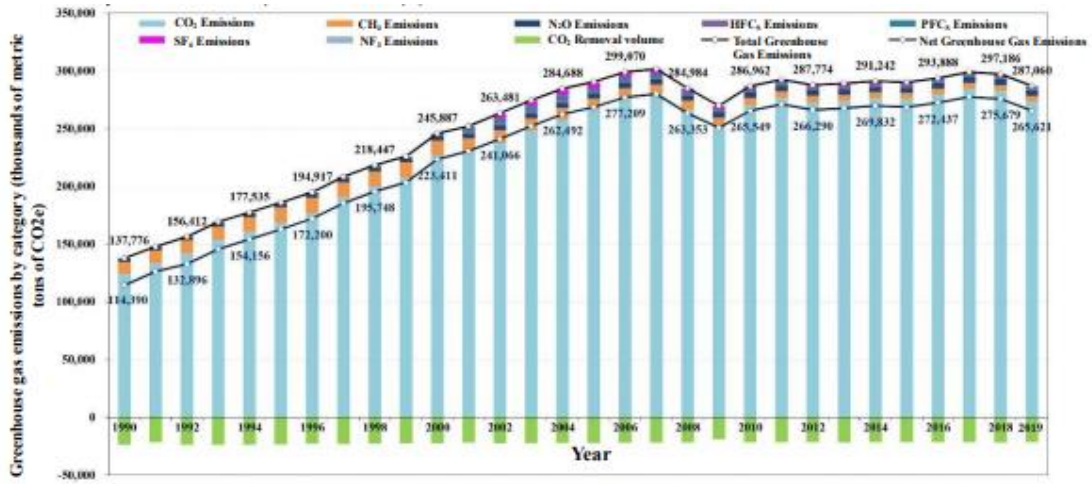

Figure 2: Trend of total greenhouse gas emissions and removals in Taiwan from 1990 to 2019

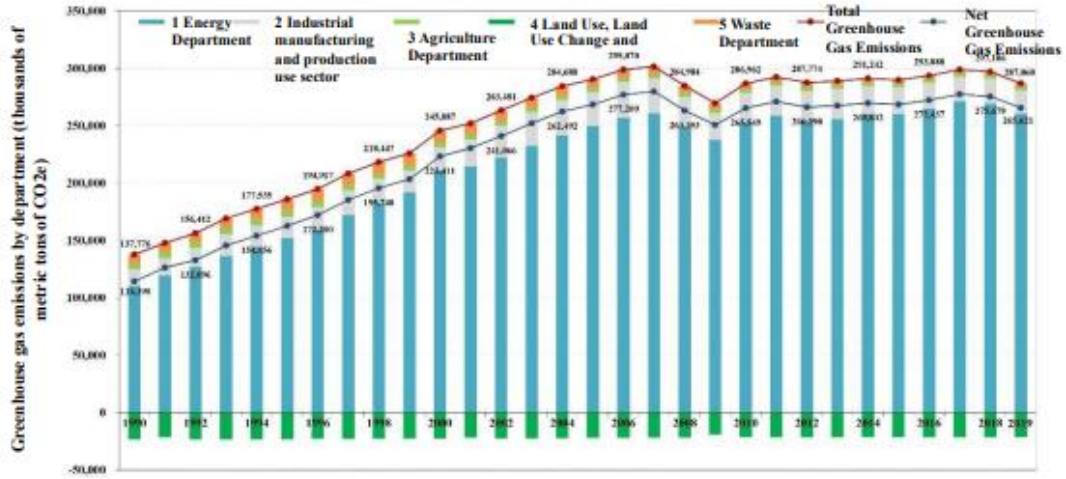

Figure 3: Trends in greenhouse gas emissions by sector in Taiwan from 1990 to 2019

Chapter 3 Greenhouse Gas Reduction Policies and Measures in Taiwan

Climate change is a cross-regional and cross-domain issue. The promotion of climate policies highly relies on the coordination between various ministries and departments, as well as the collaboration between central and local governments. In order to establish a sound climate governance framework and reduction measures, and actively promote international collaboration, the Executive Yuan coordinated and established the “Climate Change and Carbon Reduction Task Force” and the “Office of Energy and Carbon Reduction” under the National Council for Sustainable Development. The Office of Energy and Carbon Reduction is responsible for convening the “Net-Zero Pathway Task Force.”

Regarding regulations and policies, the Greenhouse Gas Management Act is adopted as the framework for coordinating Taiwan’s climate action. The Greenhouse Gas Management Act clearly sets the national long-term target for the reduction of greenhouse gases, and for related ministries/departments to develop a national-level “Climate Change Action Guideline“ and “Greenhouse Gas Reduction Action Plan.”

The content of the Action Plan comprises periodic regulatory goals, and reduction policies as well as the supporting measures and its indicators of effectiveness for the energy sector, manufacturing sector, transportation sector, residential and commercial sector, agricultural sector, and environmental sector. The key actions and achievements of each sector in 2020 are summarized as follows:

Energy sector: Construct a low-carbon energy supply system and promote energy transformation to increase the percentage of renewable energy generation to 20% by 2025. Greatly increase the installation of renewable energy, including solar photovoltaic and wind power generation. Improve the LNG unloading capacity to increase the percentage of natural gas power generation to 50% by 2025.

Manufacturing sector: Strengthen the carbon reduction actions in industries, implement industrial transformation, and promote sustainable

production processes. Reach the goal of decreasing the carbon intensity target of the manufacturing sector to 43% of the 2005 levels by 2020, ahead of schedule.

Transportation sector: Continue to increase the volume of public transportation. The volume of public transportation increased by at least 7% in 2020 compared to 2015, slowing down and reducing the use of private transportation. It is expected that the "newly purchased official vehicles and public buses will be fully electric by 2030."

Residential and commercial sector: Enhance the energy efficiency benchmarks for new building construction design, strengthen the reduction management of existing buildings, and plan to build the carbon reduction capabilities of the competent authorities in the service sector. On August 19, 2019, the "Building Technical Regulations" were amended, and the "Technical Code for Energy Conservation Design of Buildings" was implemented in 2021. It is expected that the energy efficiency benchmarks for new buildings can be increased by 5%.

Agricultural sector: Measures such as government acquisition of fishing boats and rafts, fishing moratorium rewards, subsidies for the expansion of organic and environmentally-friendly farming areas to 15,000 hectares, subsidy and acquisition policies for land and green environment, the reuse of livestock farm biogas (for power generation), policies of maintaining and ensuring the self-sufficiency of domestic livestock and poultry products, and completing afforestation with area of 3,636 hectares were implemented.

Environmental sector: When formulating policies and implementing environmental impact assessments, specific actions for resilience building and emissions mitigation should be considered, including implementing energy and resource recycling, creating a shared economic society by enhancing the reuse of regional energy resources, and reducing the emission of greenhouse gases during the treatment of waste and wastewater (sewage). Last but not least, increase the sewage treatment rate in Taiwan to 60.8% by 2020.

In response to the global trend of promoting net-zero emissions, the Office of Energy and Carbon Reduction initiated the assessment for Taiwan's net-zero emissions pathway and invited relevant ministries and departments to establish a "Net-Zero Pathway Task Force," which includes three mechanisms (five major work spheres, the model group, and the vision group) and five supporting policies for the transition (social system, green funds, behavior change, equitable transformation, and international collaboration), conducting studies on model simulation and scenario analysis related to net-zero emissions.

Taiwan has announced on October 21, 2021 that the "Greenhouse Gas Reduction and Management Act" will be amended to form the "Climate Change Response Act," which will include new regulations for the collection of carbon fees. Furthermore, it took the initiative to promote other energy and environment-related policies, such as the Electricity Act, the Renewable Energy Development Act, and the Energy Tax Act (draft), providing more comprehensive regulatory instruments and economic incentives for climate actions.

Chapter 4 Greenhouse Gas Emission Prediction

With the long-term reduction targets set by the Greenhouse Gas Management Act, and based on the mitigation potential of the energy-saving and carbon-reduction strategies of various sectors, the national and individual sectors of greenhouse gas emissions pathways were predicted. Periodic regulatory goals are set every 5 years to gradually promote the implementation of reduction policies.

Taiwan's greenhouse gas emissions pathways from 2020 to 2035 are based on the "Phase II Periodic Regulatory Goals" approved on September 29, 2021. In addition, the energy consumption and greenhouse gas emissions of each sector are estimated by their corresponding competent authority based on the unified parameter assumptions (economic growth, population) and the combined pathways. It includes the prediction pathways of fuel combustion emissions, non-fuel combustion emissions,

and carbon sinks for the six major sectors. In order to take into consideration the "With Policy Measure" during the planning of carbon reduction policies, the effectiveness of Taiwan's greenhouse gas reduction was evaluated under the "With Existing Measures' Scenario."

Under the "With Existing Measures' Scenario" and using 2005 as the base year, all the policies and measures that have been implemented and passed in Taiwan are expected to reduce greenhouse gas emissions by 2% in 2020, 10% in 2025, 20% in 2030, and 25-30% in 2035, so that the statutory target of 50% reduction by 2050 can be achieved. The information is shown in Figure 4.

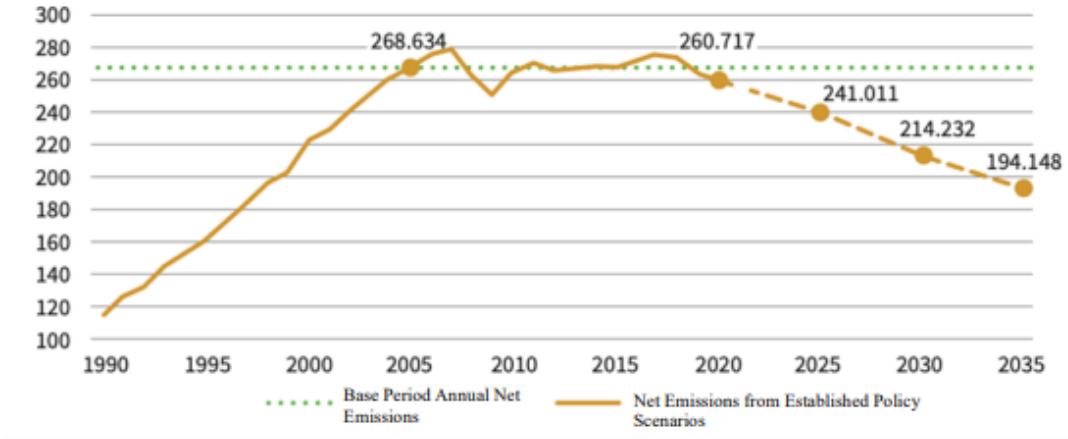

Figure 4: Net greenhouse gas emissions pathway

Chapter 5 Impacts of Climate Change and Adaptation Measures

Affected by terrain, typhoons, and frequent natural disasters such as floods and landslides, as well as the increasing occurrence of extreme weather in the future due to global climate change, Taiwan will face more threats. To respond to the impact of climate change in advance, Taiwan adopted the specifications of the IPCC Fifth Assessment Report (AR5), which defines the "risk" of climate change as a function of "hazard," "exposure" and "vulnerability" for assessment, and refined relevant policies and measures based on the assessment results.

In order to enhance Taiwan's ability to cope with climate change, after passing the "Greenhouse Gas Reduction and Management Act" in 2015, the "National Climate Change Action Guideline" was proposed, serving as the overall framework for Taiwan to promote adaptation actions. In addition, Taiwan continues to revise the related provisions of the "Spatial Planning Act," the "Coastal Zone Management Act," the "Wetland Conservation Act" and the "Water Act" to promote and review the "National Climate Change Adaptation Action Plan ."

With regards to finance, in order to adapt to the needs of climate change, government financial balance plans and green financial measures were promoted to bring about diversified financial sources. For example, damage to residential buildings caused by disasters such as typhoons or floods in Taiwan has been covered by resident insurance starting from 2020. In addition, Taiwan also encourages businesses to develop commercial-based agricultural insurance, green insurance, and issuance of green bonds to assist farmers and fishermen in reducing climate risks and provide multiple financing channels for the public, guiding funds to invest in environmentally-friendly applications. Moreover, the Taiwan Academy of Banking and Finance continues to conduct professional research and training to assist the financial industry in improving the quality of credit and the capability to undertake green energy financing. The government is also studying other fiscal and financial tools related to climate change and seeking the possibility of integrating them into the existing fiscal and financial regulations during the amendment procedures of the Greenhouse Gas Management Act.

In addition, to complete the scientific research and knowledge of the adaptation strategy, the Ministry of Science and Technology promotes the localization of climate change prediction information, strengthens the connection between scientific research and policy, and incorporates the research results into the Climate Change Integration Service Platform to build a national marine weather, hydrology, ecology, and coastal land change monitoring network, enhancing the national marine adaptation strategy and disaster response capabilities. It includes a comprehensive and

real-time national marine hydrology, ecology, and land monitoring network to carry out fundamental and long-term studies, helping the sea area of Taiwan with scientific data and technology to engage in the development of smart agriculture (fishing) industry, renewable energy, marine adaptation strategies, and homeland security, thereby cultivating national disaster response capability to cope with the intensified challenges created by climate change. As for technology and implementation, various innovative waste treatment technologies will be developed through government-industry-university-institute collaborations. Various "optimal and feasible control technologies" will be developed, and management methods, as well as standards for bringing waste into the cycle, will be established to improve resource use efficiency. The information is shown in Figure 5.

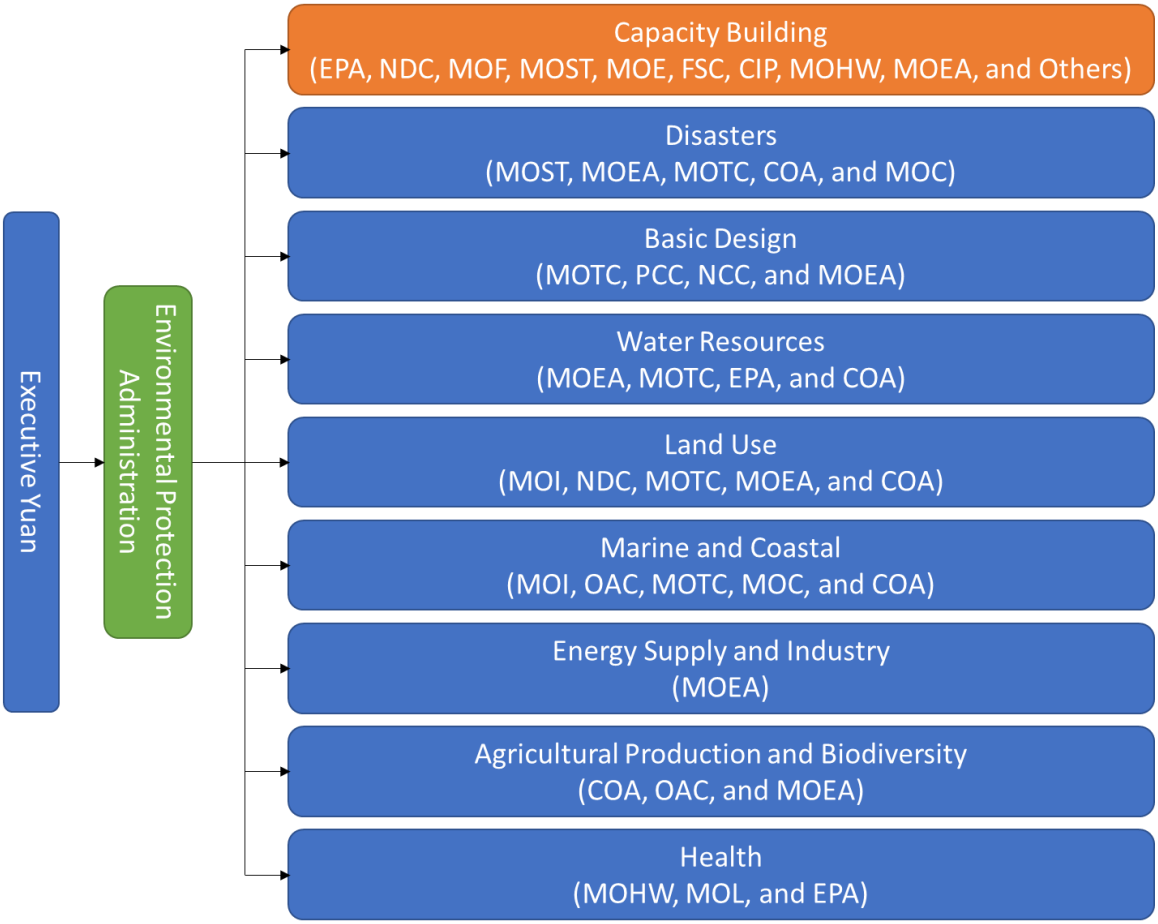

Figure 5: Division of the Adaptation Strategy to Climate Change by Ministry and Department

Chapter 6 Climate Change Scientific Research and Observations

The Ministry of Science and Technology is the central competent authority for scientific research and technology development in Taiwan. It coordinates plans and strategies for Taiwan's overall scientific and technological development, including climate-change related scientific research. In addition, the Ministry of Science and Technology also promotes cross-domain integrated research projects, builds the key capabilities for climate simulation, prediction, and interpretation, and participates in the implementation of climate-change related policies for various ministries and departments.

The promotion and management mechanism of the Taiwan's climate-change related scientific research is based on the provisions of the "Fundamental Science and Technology Act," that the Executive Yuan convenes the "National Science and Technology Conference" every four years, which serves as an important platform for the nation to coordinate science and technology policies. During the 6th National Science and Technology Conference in 2020, climate change issues were incorporated into the science and technology development policies.

The Ministry of Science and Technology has been engaging in climate science services since 2017. Through the "Taiwan Climate Change Projection Information and Adaptation Knowledge Platform (TCCIP)," climate scenarios, risk information, and adaptation tools are integrated, allowing the government, industries, research institutions, or the public to implement scientific research applications.

Meteorological observations can be roughly divided into surface meteorological observations, upper-air meteorological observations, and special meteorological observations due to differences in the scope, items, purposes, and methods of observation. To strengthen weather monitoring and forecasting technologies, and serve as a reference for the formulation of climate change risk management and adaptation policies, the government has established a five-year disaster action plan, which includes the "Hazardous Weather Monitoring and Forecasting Systems

Enhancement Project" and the "Climate Change Application Service Capacity Development Project." Through the implementation of the "Project for Strengthening Taiwan's Marine Weather and Meteorological Environment Monitoring for Disaster Prevention," the monitoring of domestic rainfall and sea area is strengthened.

Chapter 7 International Collaboration and Exchanges

Although Taiwan is not a member of the United Nations, it has always complied with and fulfilled relevant international environmental conventions and norms. Taiwan also actively participates in climate convention-related conferences and promotes exchanges and collaborations with representatives of industries, governments, universities, and research institutes from all over the world, fulfilling its obligations and responsibilities as a member of the global village.

Since 2002, Taiwan has been following the international standards recognized by the UNFCCC and continues to issue and update the "National Communication," the "National Greenhouse Gas Inventory Report," and the "Intended Nationally Determined Contribution (INDC)," implementing international environmental conventions.

1. National level

Taiwan's collaboration and exchanges with international intergovernmental organizations are mainly conducted through the help of the International Cooperation and Development Fund, which has promoted multilateral or bilateral financial collaboration, technical cooperation, and capacity building, assisting diplomatic allies or other friendly countries in developing their economy, social and human resources, and providing humanitarian aid or assistance to international refugees fleeing from natural disasters.

2. Local government level

A total of 11 cities in Taiwan have joined the International Council for Local Environmental Initiatives (ICLEI), Local Governments for Sustainability. Currently, Kaohsiung City has established the “ICLEI Kaohsiung Capacity Center (ICLEI KCC), serving as the East Asia operations center to perform the tasks assigned by the ICLEI World Secretariat and offer support to various offices in East Asia, providing member training, professional knowledge, and information exchange on the management of various environmental sustainability policies.

3. Non-governmental organizations

Regarding international initiatives, more than a hundred companies in Taiwan have joined RE100 and have made a public commitment to achieve the use of 100% renewable energy by 2020-2050, and to report their progress year on year. Among them, companies in the semiconductor and electronics field have also joined EV100, hoping to reduce carbon emissions by increasing the use of renewable energy as well as the infrastructure of electric vehicle charging stations and services. Others such as the energy productivity improvement initiative (EP100), the transparency initiative (Task Force on Climate-related Financial Disclosures (TCFD), Climate Action 100+), and the Science Based Targets Initiative (SBTi) have all been joined onto by many companies in the financial industry, the biotechnology industry, and investment institutions.

In addition, there are academic research organizations and civic groups in Taiwan that are actively participating in climate convention-related conferences, focusing on international carbon pricing trends, carbon capture, and storage technology, etc. to demonstrate their diverse and autonomous capabilities in civil society participation.

Chapter 8 Education, Training and Communication with the Public

In response to the requirements of Article 6 of the Convention for the promotion of climate change education, training and public awareness, the government has incorporated those requirements into the education system. Climate change education in Taiwan is divided into two major directions: climate change mitigation education and adaptation education. Its legal basis includes the “Greenhouse Gas Management Act” and the “Basic Environment Act”; the “Adaptation Strategy to Climate Change” in Taiwan is used as the policy basis for the adaptation of education.

As to mitigation education, a school carbon inventory is promoted to allow students to understand greenhouse gas emissions generated by school activities so that further mitigation plans can be proposed. In addition, collaboration with the government, industries, universities and research institutes for mitigation and energy technologies are carried out to increase students’ opportunities in practical participation.

With regard to the adaptation of education, school adaptation actions are promoted. Colleges and universities can prioritize the areas for adaptation according to the climate and environmental phenomenon of their campuses, and their living labs or cross-domain teaching methods.

In terms of social dialogue and public participation, the government launched a Net-Zero Pathway Task Force in 2020 to gather all walks of life in discussing the key technologies or issues of net-zero emissions and the formulation of the Energy White Paper. By increasing public participation for planning future energy policies and establishing the “Climate Talks” platform, interactive policy information and calling for online opinions can be made possible. By promoting low-carbon sustainable communities, the power and resources of the central/local governments, and private enterprises can be integrated, starting from small participation units such as communities in townships, urban areas, or villages, and gradually expanded to large participation units in big cities.

Finally, with regard to the promotion of climate empowerment by

civic groups, both the government and civic groups have actively responded to international environmental protection actions and promoted initiatives related to corporate sustainable development, such as Earth Day, the RE10x10 initiative, or organizing the Youth and National Climate Vision Forum and corporate-sponsored youth empowerment to bring together resources and lecturers, assisting in the implementation of climate change teaching materials that meet the needs of schools.